A Common Vision for the Undergraduate Mathematics Program in 2025

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CBMS Council Meeting

5 December 2014

Collective action

Develop a shared vision in the mathematical sciences community of the need to modernize the undergraduate mathematics program, especially the first two years.

Diverse stakeholders have made excellent, yet separate, recommendations for improving these courses.

Our assumptions

- Mathematical scientists -- including mathematicians, applied mathematicians, statisticians, computer scientists, and mathematical sciences educators -- can contribute to scientific initiatives to advance national priorities that are in the best interest of all citizens.

Our assumptions

- The most productive approach to preparing the next generation of STEM literate citizens will involve multidisciplinary teams of mathematicians, statisticians, computer scientists, and domain specialists from STEM and non-STEM fields, working together to modernize the undergraduate mathematics program.
- Mathematical sciences courses in the first two years of college function as pathways into many different STEM majors and also as key components in the preparation of scientifically literate citizens.

What is *Common Vision* doing?

The range of activities in support of improving undergraduate mathematical sciences is already broad.

There are consistent elements in these efforts.

Common Vision –

- **Phase I:** Introspective period. Many publications have guided our thinking. We have chosen seven curricular guides on which to focus. Each of these seven is a major enterprise endorsed by the supporting association.
- **Phase II**: Outward looking period. Focus on wide-spread dissemination and implementation of modernized curricula and delivery methods.

The seven guides

- *Beyond Crossroads*. AMATYC's 2006 update of the 1995 *Crossroads in Mathematics: Standards for Introductory College Mathematics.*
- *Guidelines for Assessment and Instruction in Statistics Education College Report*. ASA's 2012 publication with recommendations for introductory statistics curricula. The ASA's Guidelines for Assessment and Instruction in Statistics Education (GAISE) project consisted of two groups focused on K-12 education and introductory college courses, respectively. This publication presents the recommendations developed by the college group.
- *Guidelines for Undergraduate Programs in Statistical Science*. Endorsed by ASA board of directors in 2014.

The seven guides

- *Committee on the Undergraduate Program in Mathematics Curriculum Guide*. The MAA's Committee on the Undergraduate Program in Mathematics (CUPM) is charged with making recommendations to guide mathematics departments in designing undergraduate curricula. CUPM began issuing guidelines in 1953, updating them at roughly 10-year intervals. The updated guide will be endorsed by MAA board of governors in early 2015.
- *Partner Discipline Recommendations for Introductory College Mathematics and the Implications for College Algebra*. Curriculum Renewal Across the First Two Years (CRAFTY) is a subcommittee of CUPM and is charged with monitoring ongoing developments in curricula for the first two years of college mathematics and making general recommendations. This report was issued in 2012.

The seven guides

- *Modeling across the Curriculum*. This SIAM guide makes recommendations on curricula in areas relevant to applied and computational mathematics. It provides a summary of the first Modeling across the Curriculum workshop. The second Modeling across the Curriculum workshop was held in January 2014; the report is currently in preparation.
- *Undergraduate Programs in Applied Mathematics*. Released by SIAM in 2014.

Phase II: Dissemination and Implementation

Launch national *Center for the Advancement of Mathematical Sciences Education (CAMSE)*

CAMSE mission will be to facilitate implementation of proven strategies in order to:

- Increase number of students obtaining STEM degrees, and thus expand pool of STEM graduates who are well prepared for the workforce or further study in the mathematical sciences.
- Broaden participation in the mathematical sciences.
- Strengthen STEM competencies of all students, including non-STEM majors.

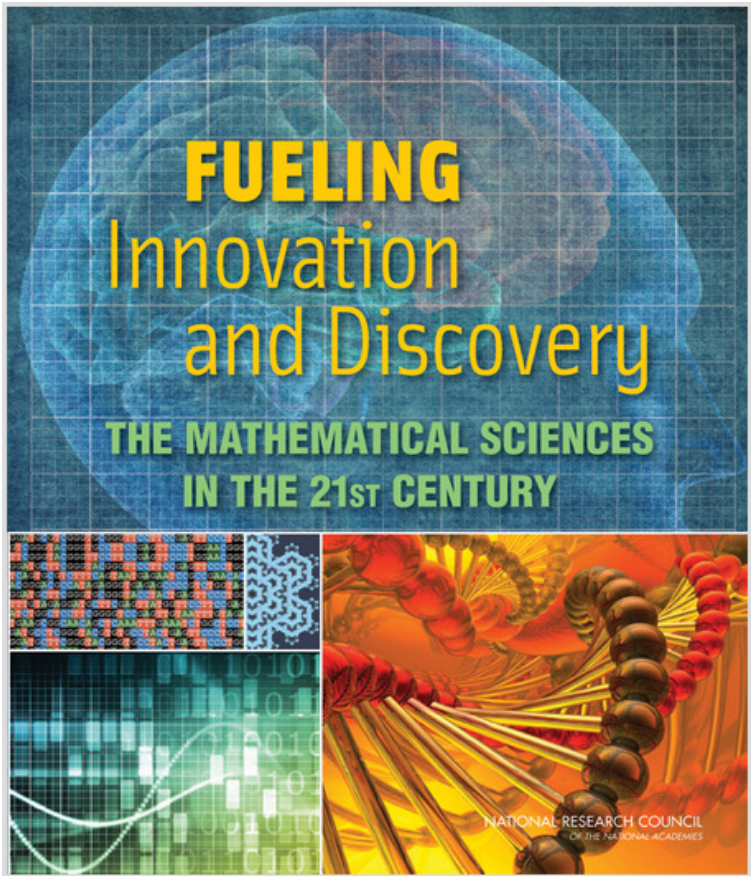
CAMSE strategies

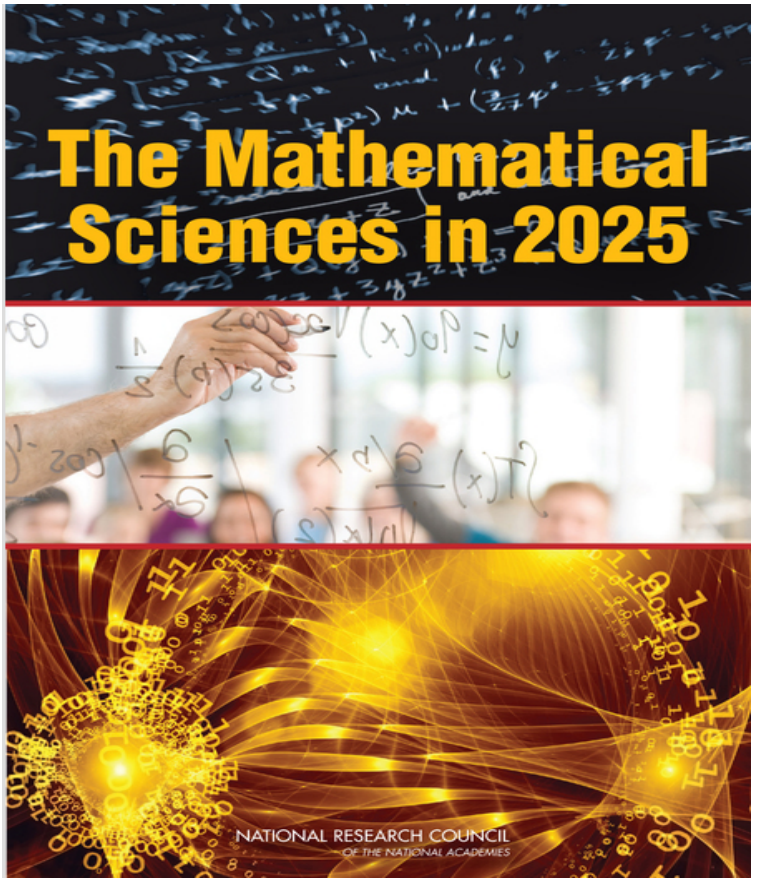
- Implement communications strategies to engage the mathematical sciences community in the quest to improve undergraduate instruction.
- Lead efforts to identify key elements of successful programs.
- Assist departments with implementing initiatives to improve student success.
- Create and maintain a database of programs and initiatives that have demonstrated potential for increasing student success.

CAMSE strategies

- Foster activities (e.g., special sessions, panel discussions, plenary talks) that focus on the mathematical training of STEM majors.
- Communicate (through, e.g., workshops and conferences) with other STEM disciplinary societies and higher-ed associations to better serve partner disciplines.
- Publish white papers on issues surrounding undergraduate mathematics education for STEM and non-STEM fields to be distributed to stakeholders.
- Work with funding agencies to identify and build on existing efforts.

Common Vision
Impetus to change

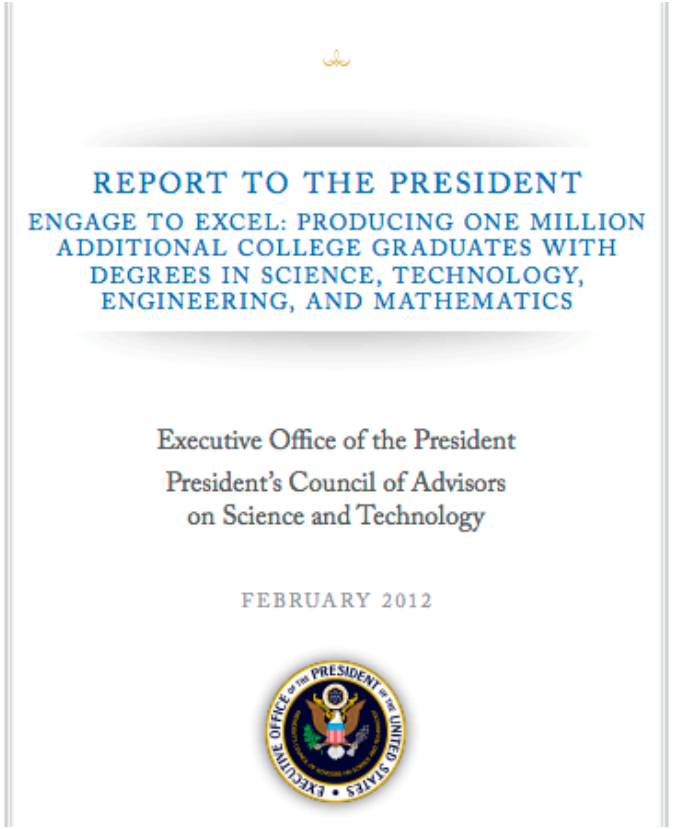




Common Vision
Impetus to change

Engage to Excel

President's Council of Advisors of Science and Technology (PCAST)



Many other resources…

Executive Office of the President

Big Data Across the Federal Government

March 29, 2012

Here are highlights of ongoing Federal programs that address the challenges of, and tap the opportunities afforded by, the big data revolution to advance agency missions and further scientific discovery and innovation.

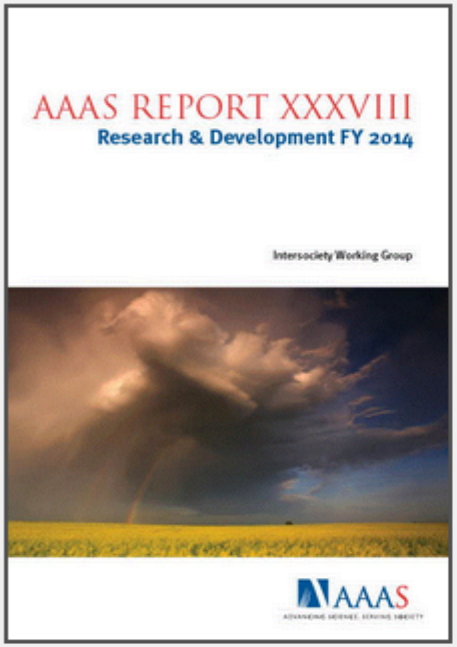
DEPARTMENT OF DEFENSE (DOD)

Defense Advanced Research Projects Agency (DARPA)
The ***Anomaly Detection at Multiple Scales (ADAMS)*** program addresses the problem of anomaly detection and characterization in massive data sets. In this context, anomalies in data are intended to cue collection of additional, actionable information in a wide variety of real-world contexts. The initial ADAMS application domain is insider threat detection, in which anomalous actions by an individual are detected against a background of routine network activity.

The ***Cyber-Insider Threat*** (***CINDER***) program seeks to develop novel approaches to detect activities consistent with cyber espionage in military computer networks. As a means to expose hidden operations, CINDER will apply various models of adversary missions to "normal" activity on internal networks. CINDER also aims to increase the accuracy, rate and speed with

Many other resources…

Date Published: 13 June 2013
Authors: Matt Hourihan



The 315-page report was officially released in June, a bit later than normal following the delayed release of the President's FY 2014 budget. This reference work provides a comprehensive analysis of R&D in the President's FY 2014 budget request, including specialized analyses by theme, major agency, and discipline.

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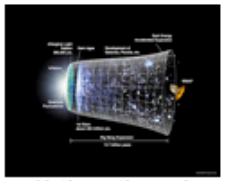
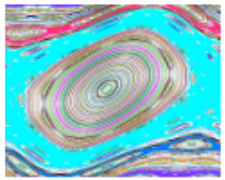
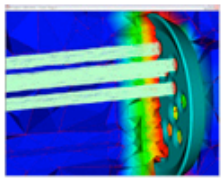
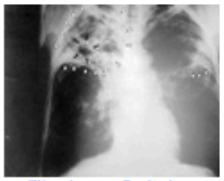

Mathematics and Cosmology »

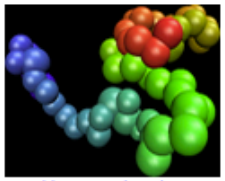
Auto safety system »


Symplectic Dynamics »


Improved Electron Gun »

A new (math) world »


Flipping a Switch »


Macromolecular Motion »

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Other NSF Supported Mathematics Institutes:

BIRS
IHES
MFO

AIM (American Institute of Mathematics) **AIM Events**
http://www.aimath.org
Palo Alto, California

AIM fosters progress in all areas of mathematics through focused collaborative research.

IAS (Institute for Advanced Study) **IAS Events**
http://www.math.ias.edu
Princeton, New Jersey

The Institute for Advanced Study is an independent, private institution dedicated entirely to the encouragement, support and patronage of learning through fundamental research and definitive scholarship across a wide range of fields.

ICERM (Institute for Computational and Experimental Research in Mathematics) **ICERM Events**
http://icerm.brown.edu/
Providence, Rhode Island

The mission of ICERM is to support and broaden the relationship between mathematics and computation and, specifically, to expand the use of computational and experimental methods in mathematics, to support theoretical advances related to computation, and to address

Common Vision project details: Leadership team

- **John Bailer** Miami University
- **Rob Farinelli** College of Southern Maryland
- **Tara Holm** Cornell University
- **Vilma Mesa** University of Michigan
- **Karen Saxe** Macalester College
- **Uri Treisman** University of Texas
- **Peter Turner** Clarkson University

Common Vision project details: "Deliverables"

- *Common Vision* Report (2015)
  - Highlight common themes of 7 guides
    [and other reports on curriculum & pedagogy]
  - Lay foundation for Phase II
- White papers
  - OSTP

Common Vision grant period: 1 Oct 2014 – 30 Sept 2015

Quotes

"The Board believes that the Nation is failing to meet the STEM education needs of U.S. students, with serious implications for our scientific and engineering workforce in the 21st century. Addressing this issue is absolutely essential for the continued economic success of the Nation and its national security. All American citizens must have the basic scientific, technological, and mathematical knowledge to make informed personal choices, to be educated voters, and to thrive in the increasingly technological global marketplace."

NSB report A NATIONAL ACTION PLAN FOR ADDRESSING THE CRITICAL NEEDS OF THE U.S. SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS EDUCATION SYSTEM [NSB-07-114]

“Scientists and engineers work for all types of employers.”

NSB Science and Engineering Indicators 2014

“Priorities include educating students to be leaders and innovators in emerging and rapidly changing STEM fields as well as educating a scientifically literate populace; both of these priorities depend on the nature and quality of the undergraduate education experience.”

http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505082&WT.mc_id=USNSF_39&WT.mc_ev=click

Thank you!

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